APPENDIX B:
KINGS BEACH W.I.P. REPORTS (SUMMARIZED)

This environmental document frequently refers to information found in several technical hydrology reports that were developed specifically for the Project. Summaries of those documents are provided here. Complete copies are available from Placer County.

NOTE: the references cited in these summaries do not correspond to the references listed in Section 9 of this environmental document. To see correct lists of the references cited in these summaries, please refer back to the complete copies available from Placer County.

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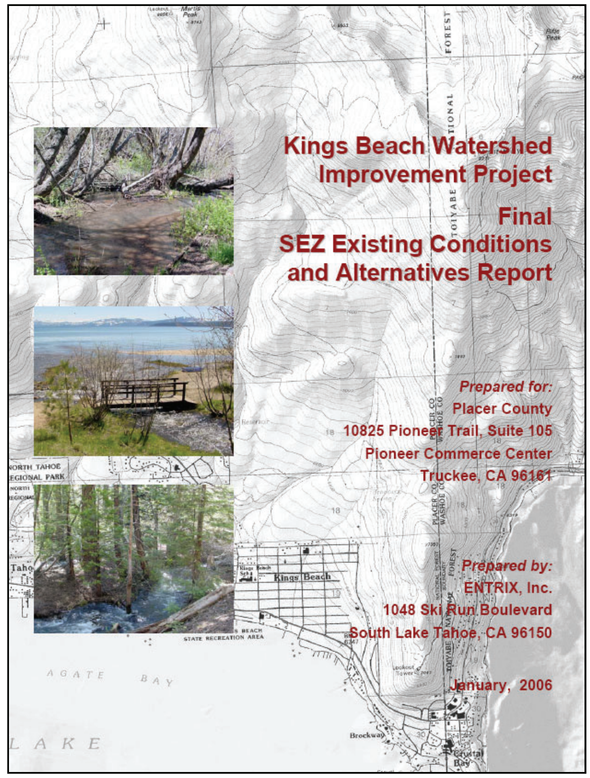


Appendix B-1
Summary of Final SEZ Existing Conditions and Alternatives Report

This report focuses on analyses and alternatives development for the Griff Creek and Coon Street SEZs within and up-gradient of the Kings Beach commercial and residential areas.

An SEZ is a natural stream and its drainage, including associated marshes and meadows. SEZs comprise only about 11% of the total land area of the Tahoe Basin. Preservation of the natural pollutant treatment and runoff conveyance provided by SEZs are considered essential to Lake Tahoe's water clarity, as these areas remove sediment and adsorbed contaminants from upland runoff before it reaches sensitive lentic environments. Besides providing water quality benefits, SEZs have important wildlife, scenic, and recreational values.

Detailed assessments of the sediment production, and ecological and pollutant filtering attributes of two SEZs mapped by the TRPA were analyzed as part of this project. These include:

1. The lower west fork of Griff Creek from its mouth at Lake Tahoe upstream to the southern boundary of the CTC-owned parcel (approximately 8,500 ft), and

2. The Coon Street SEZ within the Kings Beach subdivision that roughly parallels Coon Street and crosses Speckled Avenue near Fox Street (approximately 3,500 ft).

The SEZ assessments included analyses required to gather the information necessary to identify alternatives and develop a recommended SEZ improvement plan that could:

1. Improve lake and stream water quality benefits,

2. Increase channel stability and natural stream geomorphic processes,

3. Improve riparian and fish habitat, including removal of barriers to fish migration,

4. Restore wet meadows/wetlands,

5. Protect sensitive species,

6. Provide cost benefits in consideration of all applicable TRPA threshold benefits,

7. Enable compatibility with the recommended project for improvement of subdivision runoff prior to discharge to Lake Tahoe, and

8. Generate cooperation of stakeholders, including local residents.

During the course of development of this report, several existing literature sources related to Griff Creek SEZ restoration were reviewed to understand the extent of available information and its relevance to the project:

- TRPA Kings Beach Community Plan

- TRPA Griff Creek Environmental Improvement Plan Assessment – Project 410

- Griff Creek Erosion Control Project – Water Quality Monitoring Report: Water Years 1985-1993

- Brockway Salvage Timber Sale – Water Quality Monitoring Report: Water Years 1991-1998

- Wolf Street Stream Zone Restoration Project

- Griff Creek Dam Removal and Channel Reconstruction – 199

- Task 8 Draft Report: Griff Creek Permitting Consultation and Hydraulic Analysis **–** March 2003

- Forest Habitat Enhancement Program – Environmental Documentation and Related Studies Being Prepared by EDAW, Inc. for the California Tahoe Conservancy

- Mainstream Restoration **–** Preliminary Griff Creek SEZ Restoration Work: 2004-2005

Each of the literature sources listed above is summarized in this report. ENTRIX also coordinated with other groups currently working on, or have recently worked on, restoration projects in the Griff Creek watershed.

GRIFF CREEK SEZ

This report describes the Griff Creek environmental setting, including watershed area, elevation, soils, historic disturbance, geology, geomorphology and riparian vegetation.

Griff Creek is a steep mountain stream that flows from its headwaters at over 9,600 ft downstream through mostly forested terrain before passing through urbanized Kings Beach and out into Lake Tahoe (median lake elevation of 6225.6 NGVD29 ft). Griff Creek's relief is nearly 3,400 ft in approximately 4.2 miles, with an average valley slope of 15%. The majority of the watershed is USFS land, with some large forested parcels that are owned by the CTC. Development is minimal in the USFS and CTC land, and is primarily limited to old logging and fire access roads.

The Griff Creek channel has been subjected to relocation, straightening, widening, deepening, and rip-rapping (i.e., channelization). Past and ongoing watershed disturbances have altered the flow and sediment balance of Griff Creek, resulting in degraded channel form and lost ecological integrity within the SEZ. Almost all development is within the lower one-third of the Griff Creek watershed. The development includes the Kings Beach commercial and residential areas that extend north up Highway 267 to the Canterbury Drive crossing with Griff Creek. Urban encroachment has caused the most obvious degradation of the SEZ ecosystem in the lower third of the watershed. Most of Griff Creek downstream of Speckled Avenue, particularly the right bank (direction looking downstream), has infrastructure, such as homes, businesses, backyards, and parking lots, very near or directly against the channel. Most of this infrastructure has been constructed on imported fill that eliminated SEZ areas and laterally confined the channel. In addition, five road crossings have contributed to the channel and floodplain degradation. All of these road crossings have eliminated or reduced floodplain connectivity, and many have undersized, failing culverts that degrade the channel and negatively affect fish passage. Riparian vegetation in the existing SEZ consists primarily of willows and alders (with cottonwoods, aspens, pines, firs, and/or incense cedar interspersed) of varying densities and widths, depending on the extent of development adjacent to the channel, valley width, slope, and channel form (single or multi-channeled).

Analyses of channel bed slope, channel morphology, riparian vegetation, floodplain connectivity, and urban encroachment were all utilized to develop the project channel reaches. A total of 15 Griff Creek reaches have been designated between Lake Tahoe and Canterbury Drive (Table ES-1). The objective of creating the reach breaks is to organize the creek into areas operating under similar processes and exhibiting similar channel and floodplain conditions. Organization of the channel into reaches is intended to facilitate the identification of opportunities and constraints to developing restoration alternatives.

A hydraulic model of Griff Creek was created (using HEC-RAS) to determine the average flow at which overbanking occurs, and estimate the shear stress for incipient bed sediment motion. The conclusions from the overbank analysis are:

1. There is effectively no potential for overbanking (except for the in-channel sediment basin) in the channel constructed as part of Placer County's 1984 Phase I Erosion Control Project (Lake Tahoe to RS 9+95),

2. Channel incision is most severe from upstream of the constructed channel (RS 9+95) to around RS 14+00. Overbanking into the left floodplain is estimated to occur once every 6 to 8 years.

3. Although the channel is degraded between RS 14+00 and RS 19+50, it is less incised than immediately downstream and likely floods once every 4 to 5 years. Flood channels in the left floodplain have eliminated some of the potential for erosion in the primary channel.

4. Urban encroachment and fill on the right bank for most of Griff Creek downstream of Dolly Varden Avenue has eliminated almost all potential for floodplain connectivity.

5. A rock-lined channel and urban encroachment along the right bank upstream of Dolly Varden Avenue have reduced overbanking frequency and floodplain area. The greatest potential for improving floodplain connectivity in this area is on the left bank near the Wolf Street fill removal area.

6. Incision of the flood channels in the meadow upstream of Speckled Avenue has reduced the potential for flooding of this area.

7. The primary channel upstream of Speckled Avenue exhibits little evidence of recent degradation.

Table ES-1. Griff Creek Geomorphic Reach Breaks

Reach #	DS RS	US RS	Length (ft)	Channel Planform	Reach Bed Slope	Geomorphic Channel Type	Average Overbank Flow Estimate (cfs)	Estimated Overbank Frequency (years)	Reach Characteristics
1	0	2+17	217	Primary	0.03	Riffle-step	2,000	> 100	A steep channelized reach constructed in 1984 as part of the Placer County Phase I Erosion Control Project. Rip-rapped banks in trapezoidal channel with very high conveyance capacity.
2	2+17	5+20	303	Primary	0.01	Plane-bed	1,000 to 1,200	45	A channelized reach immediately DS of the Hwy 28 bridge constructed in 1984 as part of the Placer County Phase I Erosion Control Project . Rip-rapped banks in trapezoidal channel with very high conveyance capacity. A lower bed slope than DS reach enables minor incipient floodplain formation. Poor aquatic habitat value because of the high volume of silt/clay material overlying very coarse bed material throughout reach.
3	5+20	7+88	268	Primary	0.01	Riffle-step	400 to 500	9 to 10	A channelized reach immediately US of the Hwy 28 bridge constructed in 1984 as part of the Placer County Phase I Erosion Control Project . Rip-rapped banks in trapezoidal channel with very high conveyance capacity. Reach contains the in-channel sediment retention basin also constructed as part of the 1984 project.
4	7+88	9+95	207	Primary	0.034	Riffle-step	500	9 to 10	The US reach boundary at RS 995 marks the most upstream extent of the channelized reach constructed in 1984 as part of the Placer County Phase I Erosion Control Project. Rip-rapped banks in trapezoidal channel with very high conveyance capacity.
5	9+95	14+85	490	Primary	0.024	Riffle-step	125 to 300	4 to 8	The DS reach boundary at RS 995 marks the end of the rip-rapped, trapezoidal channel constructed in the 1984 Placer County Phase I Erosion Control Project. This is the most incised reach in the project area. Overbank discharges in the lower half of the reach are about 250 to 300 cfs, which only occur about ever 7 to 8 years. This is also the first reach from the lake that is a source of fine grained sediment. Channel banks are not protected continuously with rip-rap, and show evidence of undercutting and bank collapse. Cut tree stumps in the channel indicate the channel may have recently occupied this location, or has widened substantially. Remnant channels in the abandoned floodplain left of the channel further suggest the channel has been relocated, or because of incision and increased flow conveyance capacity of the active channel, the remnant channels are very infrequently flooded. The parcels left of XS 16 and XS 17 cut-off a potential flooplain connection with the active flooplain US of this reach.
6	14+85	21+80	695	Primary, Flood	0.024	Riffle-step (Cascade DS of Dolly Varden Avenue)	100 to 150	4 to 5	The first area of active floodplain from the lake is located left of the channel between RS 1485 and Dolly Varden Avenue. During annual high flow the left culvert outlet at Dolly Varden Avenue diverts approximately 20% of the total Griff Creek flow into a flood channel and down into the left active floodplain. Since the floodplain conveys a portion of the high flow, the primary channel is less incised in this reach than in the reach downstream with no floodplain connection. Inundation of the floodplain is primarily from the flood channels, since the primary channel is still incised and infrequently overbanks. Some sections of the primary channel's banks are undercut with exposed tree roots, while other sections have been protected by rip-rap placed along banks near homes.
7	21+80	23+20	140	Primary, Secondary	0.024	Riffle-step	150 to 175	4 to 5	Immediately upstream of Dolly Varden Avenue, at RS 2275, the primary channel splits around a residential driveway into 2 perennial channel branches. The primary channel stays to the left, and the secondary rock-lined channel heads to the right under a separate culvert at Dolly Varden Avenue. All throughout this reach, the channel is heavily encroached upon along the right bank by residences and rip-rap. The Wolf Street fill removal project created the opportunity for relatively frequent overbanking into the left floodplain on CTC property near RS 2300. As a result, the channel is less incised where high flows can spill out onto the floodplain. Upstream of RS 2300 the creek's left bank is located on private property and away from the fill removal project, resulting in less opportunity for overbanking onto the left floodplain and a more incised channel than downstream.
8	23+20	27+40	420	Primary	0.024	Riffle-step	100	4	Homes are much further set back from the channel's right bank than in the reach downstream. Lots of woody debris is scattered throughout the channel. Channel banks are natural and exhibit some evidence or prior instability, but are not a substantial sediment source. Water velocities slow in this reach as some of the flow spreads out and floods small floodplain benches adjacent to the channel. However, the larger floodplain surface to the left between the channel and Wolf Street is flooded less infrequently than in the reach downstream.
9	27+40	28+15	75	Primary	0.085	Cascade	> 1000	> 50	A steep reach with flow from Speckled Avenue culverts cascading over large bed material. No floodplain because of the confining left and right bank fill associated with the Speckled Avenue road crossing.

Table ES-1. Griff Creek Geomorphic Reach Breaks (continued)

Reach #	DS RS	US RS	Length (ft)	Channel Planform	Reach Bed Slope	Geomorphic Channel Type	Average Overbank Flow Estimate (cfs)	Estimated Frequency (years)	Reach Characteristics
10	28+15	32+00	385	Primary, Flood	0.035	Riffle-step	90 to 150	4 to 5	Urban encroachment along Griff Creek upstream of Speckled Avenue is minimal compared to reaches downstream. Most homes near the creek are located up on hillslopes away from the banks and out of any potential floodplain. During annual high flows at RS 3200, about 25% of Griff Creek's total flow is diverted by large wood in the channel down a flood channel to the right. The flood channel flows to the right and into a meadow where it splits into two flood channels. The two flood channels eventually join together again before flowing into a small culvert at Speckled Avenue. The flood channels are incised and infrequently overbank onto the meadow (about once every 3 to 4 years). Incision of the flood channels may be related to an undersized culvert at Speckled Avenue. Rock grade control constructed in the flood channel in the past appears to have halted continued upstream advancing channel incision. The primary channel is largely laterally confined by the left valley wall and an upland island that separates the channel from the flood channels in the meadow to the right.
11	32+00	41+55	955	Primary, Flood	0.035	Step-pool	40 to 100	3 to 4	The East Fork Griff Creek confluences with Griff Creek in this reach. At RS 4155 (XS 40), a low-water bridge spanning the West Fork Griff Creek backs up water and diverts a portion of the annual high flow left into a flood channel. The primary channel has locally widened around the bridge since the very low capacity bridge lying directly on the bed forces a portion of the flow around the bridge. The West Fork Griff Creek flood channel traverses to the left until confluencing with the East Fork Griff Creek. The East Fork Griff Creek captures the flood water and conveys it downsteam until confluencing with the West Fork Griff Creek at RS 3450. Downstream of the confluence, Griff Creek is single thread. Some evidence of bank undercutting suggests the channel may have downcut somewhat in the past. Yet, overall the channel banks in this reach are well vegetated and are not a significant sediment source. Although much of the valley floor vegetation in this reach is composed of riparian species, it appears that they are hydrologically supported by groundwater instead of frequent channel overbanking. Several large channel steps are located throughout the reach, some of which appear to be artifically constructed (near XS 36). Many of the tall natural steps are composed of, or were augmented by large wood in the channel.
12	41+55	50+80	925	Primary	0.05	Riffle-step	40 to 100	3 to 4	The West Fork Griff Creek is single thread throughout the entire reach. Urban encroachment is mostly limited to two homes on the creek's right bank near cross-sections 41 and 42. A culvert is positioned longitudinally in the chanel along the right bank at XS 41. This culvert may have been placed for bank protection, or could be a remnant of the road that used to cross the channel at this location to access the former dump site on the left side of the valley. Fill used to construct the old road disrupts the hydrologic connection between left floodplain up and downstream of the road. The channel is more steep and laterally confined by valley walls in this reach compared to reaches downstream. Opportunities for overbanking onto floodplain are limited to small pockets along the creek. There is a lot of wood in the channel, and little evidence of channel instability.
13	50+80	54+00	320	Primary, Secondary	0.05	Cascade, Step-pool	30 to > 1,000	2 to > 50	The channel immediately downstream of Cambridge Drive is steep with cascading flow over large bed material. Near RS 5280, the channel slope decreases substantially and the flow splits into two channels in an open grassy area with large cut tree stumps. The majority of the water flows down a steep channel along the base of the left valley wall. The rest of the water continues down a less steep channel along the base of the right valley wall. These two heavily wooded channels confluence at RS 5080. The nature of the land use disturbance at the head of these two split channels, and its role in the dynamics of the split channels is not clear. Since the left primary channel has a much steeper slope, it has the potential to capture all of the flow in the future.
14	54+00	64+25	1025	Primary, Secondary, Flood	0.07	Step-pool	40 to 100	3 to 4	The West Fork Griff Creek continues to steepen upstream in this reach. During annual high flow at RS 6425, a portion of the total channel flow is diverted into a flood channel. This flood channel traverses to the right, splits into two channels for a distance, and remains along the base of the right valley wall before confluencing with the primary channel just upstream of the culverts at Cambridge Drive. Evidence of channel instability is minimal in this reach. The apartment complex located along the entire right valley is elevated far enough up the hillslope that it does not directly impact the channel or floodplain. The primary channel that flows along the base of the left valley wall has large steps composed mainly of large cobbles and small boulders, as well as large wood. Overbanking does not appear to occur very frequently. Instead, high flows are routed down secondary of flood channels.
15	64+25	73+50	925	Primary	0.068	Step-pool	40 to 100	3 to 4	The entire channel in this reach is single thread. Urban encroachment is limited to an apartment complex located away from the channel and floodplain on the right valley hillslope, and a water tower on the right bank at RS 6765 (XS 66). The water tower cuts into the small riparian corridor along the right bank. The channel has downcut near the water tower, likely because of the tower's constriction of flood flows. The right hillslope upstream of RS 6700 has large unvegetated sections near the channel that could deliver fine sediment to the channel from hillslope runoff.

In addition to the detailed SEZ assessments, a stream reconnaissance of the West and East Forks of Griff Creek up to their headwaters was conducted to better understand watershed processes that may ultimately impact lower Griff Creek SEZ conditions. The overall conclusion of the upper watershed assessment is that nothing observed in Griff Creek's East Fork and West Fork (upstream of the project boundary at Lake Vista Road) watersheds should affect the SEZ restoration planning downstream in the project area. Very few raw sediment sources resulting from human disturbance were observed. The channel morphology does not indicate that the upper Griff Creek system is transporting a large slug of sediment downstream. It is expected that under the prevailing conditions, the sediment supply delivered to Griff Creek from higher up in the watersheds should not radically deviate from the existing condition.

COON STREET SEZ

This report also describes the Coon Street SEZ environmental setting. The Coon Street watershed is located east of Griff Creek in Kings Beach. The watershed drains about 287 acres of land and empties into Lake Tahoe. Most of the upper Coon Street watershed is forested land owned by the USFS. Approximately the lower third of the watershed is in heavily urbanized Kings Beach. The Coon Street drainage is seasonal; water only flows through the drainage during spring snowmelt runoff and after large rainstorms.

Opportunities for restoration of the Coon Street SEZ are largely limited to highly fragmented open fields along the drainage's course in parcels that have not been developed. For much of the drainage, water is conveyed through rock lined ditches along the side of the road, in backyards, in-between homes and businesses, and through culverts under roads. At the intersection of Brook Avenue and Coon Street, the drainage goes subsurface and does not reemerge until the south side of Highway 28 on a beach at Lake Tahoe.

The overall conclusions of the Coon Street SEZ assessment are:

1. Little potential exists for sediment and pollutant storage within the SEZ from Rainbow Ave to the outflow at Lake Tahoe as the flow is subsurface.

2. The ecology, hydrology, and geomorphology of the Coon Street SEZ is adversely affected by culverts, rip-rap, drainage ditches, and development that confine the flow to the channel and constrict the floodplain to relatively small areas or no floodplains through most of the reach. Floodplain connectivity is minimal.

3. A few open lots (fields) occur which support some riparian species that could potentially be restored to support native riparian species and to facilitate sediment and pollutant storage.

RESTORATION ALTERNATIVES

This report concludes with identification of Griff Creek and Coon Street SEZ restoration alternatives. Twenty priority areas ("enhancement sites") have been identified for Griff Creek in which improvements could be implemented to improve water quality, geomorphic channel stability, floodplain connectivity, riparian habitats, and fish passage.

GRIFF CREEK SEZ RESTORATION ALTERNATIVES

Table ES-2 presents the Griff Creek SEZ restoration alternatives.

Coon Street Restoration Alternatives

Three alternatives are presented for improving the water pollutant filtering capabilities and habitat value of the Coon Street SEZ. The potential for restoring SEZ along the Coon Street drainage is much more limited than along Griff Creek. Much of the Coon Street SEZ is very highly encroached upon by urban development. Existing parcels that are not developed and have the potential to provide water pollutant filtering and riparian habitat are very fragmented. On Griff Creek, many of the homes and businesses are located on hillslopes away from the channel. This is largely not the case on Coon Street. Most of the infrastructure is directly adjacent to and at the same elevation as the ditches and channels. The very close proximity of the infrastructure to the channel is a major constraint on proposing alternatives that would increase the amount of overbanking in the open fields and elevate flooding risks.

Alternative 1

Many of the culverts along the Coon Street drainage are in poor condition. They are either blocked with debris or are undersized and do not provide the level of flow conveyance necessary. Natural channels in open fields along the drainage are typically incised up and downstream of culverts. Replacing the culverts with larger capacity, bottomless culverts would enable a better hydrologic transition up and downstream of culvert crossings. An increase in conveyance capacity may prevent further degradation of the channels.

Alternative 2

Similar to Alternative 1, replace the culverts with larger capacity, bottomless culverts that would enable a better hydrologic transition up and downstream of culvert crossings. In addition, add roughness elements (e.g., large wood, rock) to the channels to promote more frequent overbanking. This option would likely require flood protection measures, such as constructing levees, to protect adjacent properties from flooding.

Alternative 3

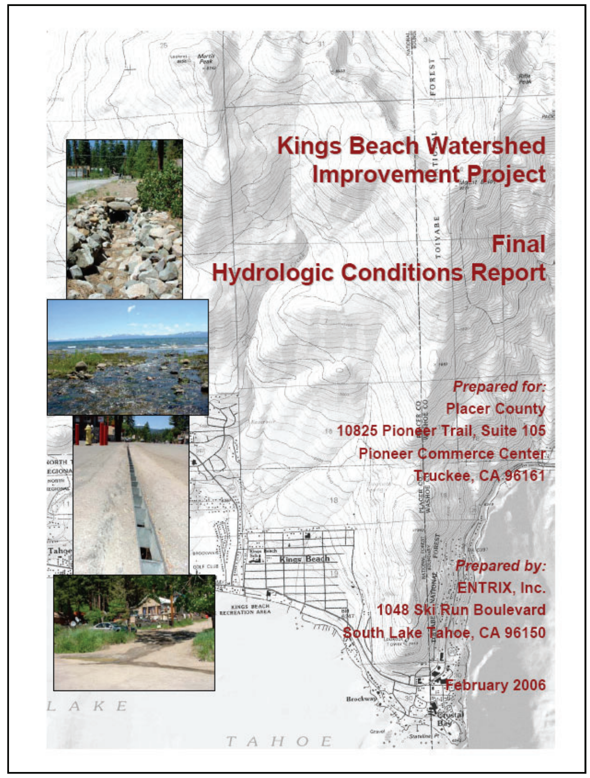
Replace culvert crossings with bridges to provide a floodplain connection beneath road crossings. This alternative would be most effective if strategic parcels that are currently developed could be acquired and converted into new SEZ habitat. The new SEZ habitat could be linked with existing open fields to create a more contiguous SEZ with much greater potential for pollutant filtering and ecological value.

Table ES-2. Griff Creek SEZ Alternatives Descriptions

Enhancement Site ID	Enhancement Opportunity	Alternative 1	Alternative 2	Alternative 3
1	Griff Creek downstream of Highway 28 is a trapezoidal, rip-rapped channel constructed in 1984 as part of Placer County's Phase I Erosion Control Project. Because of the channel's high conveyance capacity, a 50 to 100 year flow event is needed for overbanking to occur, limiting any SEZ connection. The high terrace east of the channel has little ecological value and no Griff Creek pollutant filtering potential.	Excavate a portion of the left bank fill on the large Placer County owned parcel east of the channel to create a new floodplain surface. Construct a levee around the perimeter of the new inset floodplain to provide flood protection for adjacent properties and infrastructure. Remove the left bank rip-rap to enhance fish habitat and enable lateral channel movement.	Excavate a portion of the left bank fill on both the Placer County and CTC parcels east of the channel to create a new floodplain surface. Construct a levee around the perimeter of the new inset floodplain to provide flood protection for adjacent properties and infrastructure. Remove left bank rip-rap to enhance fish habitat and enable lateral channel movement. Construct a flood channel to divert some of Griff Creek's high flow into a wet meadow where pollutants could be filtered. Provide a water treatment area in the new floodplain for Secline Street runoff.	
2	Highway 28 culverts do not meet conveyance requirements of CALTRANS and the Placer County SWMM (Mactec, 2003). Furthermore, they prevent any potential floodplain connectivity up and downstream of Highway 28.	Replace the two 30-inch circular culverts with an additional arch culvert to enhance flow conveyance capacity.	Replace the arch and circular culverts with channel spanning, natural bottom culverts to enhance fish passage and improve conveyance capacity.	Replace all culverts with a bridge that would enable floodplain connectivity up and downstream of Highway 28. This alternative is contingent on removing the fill east of the channel at Site 3 and creating a new floodplain.
3	The function of the in-channel sediment basin upstream of Highway 28 has the potential to be enhanced. The trapezoidal, rip-rapped channel constructed 1984 as part of Placer County's Phase I Erosion Control Project upstream of Highway 28 has high flow conveyance capacity and only overbanks approximately every 9 to 10 years.	Develop a management plan for the in-channel sediment basin. The USFS (1995) water quality study indicated that the ability of the basin to trap sediments diminished rather quickly after filling up with sediment. Periodic dredging of the basin could enable increased sediment deposition and pollutant filtering.	Excavate a portion of the large Placer County parcel east of the channel to create a new floodplain surface. Remove the left bank rip-rap to enhance fish habitat and enable lateral channel movement. Construct a flood channel that would divert some of the high flow into the new floodplain where sediment and pollutants could be deposited and stored.	Excavate a substantial portion of the large Placer County parcel east of the channel to create a new floodplain surface. Construct a levee around the perimeter of the new inset floodplain to provide flood protection to adjacent properties. Reconfigure the existing channel by constructing a new primary and flood channel(s) in the new floodplain. This alternative is contingent on constructing a bridge at Highway 28 to enable floodplain connectivity up and downstream of the bridge.
4	This is the most incised Griff Creek reach and the largest channel source of fine-grained sediment from bank failure. Parcels on both sides of the channel are privately-owned. The land east of the channel is largely an undeveloped, abandoned floodplain with remnant channels. The primary channel overbanks into the abandoned floodplain about once every 4 to 8 years.	Construct in-channel grade control features (e.g., check dams, rock weirs, large wood) to prevent additional potential incision. Structures would also add channel roughness that would decrease channel capacity and enable overbanking to occur at a lower discharge. Construct bank stabilization along sections of the eroding banks (e.g., rock wall, large wood, and bioengineering).	Obtain a drainage easement along the left bank and excavate a portion of the left bank to create a new inset floodplain re-connected to the existing primary channel. Possibly divert some of the high flow in the primary channel upstream into the remnant channels. Construct bank stabilization along sections of the eroding banks (e.g., rock wall, large wood, and bioengineering).	Purchase all of the parcels east of the channel. Lower the surface of these parcels through excavation, fill the existing primary channel, and constructed a new primary channel and flood channel(s) through the inset floodplain.
5	Two parcels between cross-sections 16 and 17 disconnect the longitudinal connectivity of the left floodplain. Upstream of these parcels, the floodplain is active, with fairly regular overbanking events. The abandoned floodplain downstream of these parcels is not inundated as frequently. Griff Creek is incised in this reach and has sections of unstable banks.	Construct in-channel grade control features (e.g., check dams, rock weirs, large wood) to prevent additional potential incision. Structures would also add channel roughness that would decrease channel capacity and enable overbanking to occur at a lower discharge. Construct bank stabilization along sections of the eroding banks (e.g., rock wall, large wood, and bioengineering).	Obtain a drainage easement along the left bank and excavate a portion of the left bank to create a new inset floodplain re-connected to the existing primary channel. The new floodplain would provide a link with the active floodplain upstream and the abandoned floodplain downstream. Construct bank stabilization along sections of the eroding banks (e.g., rock wall, large wood, and bioengineering).	Purchase the two parcels east of the main channel. Remove the fill at these parcels, fill the existing primary channel, and construct a new primary channel and flood channel(s) through the inset floodplain. This would enable connection of the existing flood channels in the active floodplain upstream and remnant channels in the abandoned floodplain downstream.
6	The land east of the channel is active floodplain. Griff Creek channel incision is less in this reach than downstream. The channel overbanks into the floodplain about once every 4 to 5 years. The floodplain is actively supported by diversion of some of the high flow at Dolly Varden Avenue into a flood channel that traverses through the floodplain. Overbanking of the flood channel(s) currently provides the best pollutant filtering opportunity on lower Griff Creek.	Construct in-channel grade control features (e.g., check dams, rock weirs, large wood) to prevent additional potential incision. Structures would also add channel roughness that would decrease channel capacity and enable overbanking to occur at a lower discharge.	Reconfigure the connection between the flood channel and left culvert outlet at Dolly Varden Avenue to activate the flood channels at lower magnitude flows, and divert a higher percentage of high flows into the flood channel. May require flood protection measures for property located adjacent to the flood channels.	This alternative is contingent upon replacing the culverts at Dolly Varden Avenue with a bridge, and removal of the parcels east of the channel at cross-sections 16 and 17. A new bridge at Dolly Varden Avenue would enable a better hydrologic connection up and downstream of the road. Similar to Alternative 2, modify the head of the flood channels so they receive flow more often. In addition, reconstruct the downstream end of the flood channels so they would continue to flow through the excavated parcels at cross-sections 16 and 17 and into the re-activated floodplain downstream.
7	These culverts are a barrier to floodplain flow. The right culvert outlet at Dolly Varden Avenue is suspended about 1 ft above the channel bed, and is a barrier to fish passage.	Reconstruct the left culvert to enhance fish passage and improve conveyance capacity.	Replace the culverts with channel spanning, natural bottom culverts to enhance fish passage and improve conveyance capacity.	Replace the culverts with a bridge. This option would expand the active floodplain downstream of Dolly Varden Avenue to upstream of the road, and enhance fish passage and conveyance capacity.

Table ES-2. Griff Creek SEZ Alternatives Descriptions (continued)

Enhancement Site ID	Enhancement Opportunity	Alternative 1	Alternative 2	Alternative 3
8	Urban encroachment along Griff Creek's right bank is dramatic in this reach. Although Griff Creek is less incised upstream of Dolly Varden Avenue compared to reaches downstream, existing overbank opportunities are still limited, and only occur about once every 4 to 5 years. A great opportunity is available to enhance the hydrologic connectivity between the channel and the undeveloped CTC land east of the channel.	Construct in-channel structures (e.g., check dams, rock weirs, large wood) to prevent additional potential incision. Structures would also add channel roughness that would decrease channel capacity and enable overbanking onto the CTC property east of the channel to occur at a lower discharge. May require flood protection measures for property located very close to the right channel bank.	Near XS 25, where Griff Creek's left bank is adjacent to the CTC property east of the channel (Wolf Street fill removal site), overbanking occurs relatively frequently (about every 2 to 3 years). Upstream of XS 25, the channel is disconnected from the fill removal site, and becomes more incised. Obtain a drainage easement to excavate a portion of the left bank on private property to create a new floodplain surface.	Similar to Alternative 2, obtain a drainage easement to excavate a portion of the left bank on private property to create a new floodplain surface. In addition, construct a flood channel through the land east of the channel that would connect with the active floodplain east of the channel downstream of Dolly Varden Avenue. This alternative is contingent upon replacing the Dolly Varden Avenue culverts with a bridge.
9	The culverts at Speckled Avenue are in poor condition. The small circular culvert right of the main channel that conveys water from the meadow flood channels is undersized. Incision of the meadow flood channels may be related to the configuration of this culvert. The flood channel culvert outlet is submerged under high flow and provides poor fish passage. The right culvert of the two twin main channel culverts is blocked and does not convey any flow.	Reconfigure the flood channel culvert so it is no longer submerged during high flow. Also, clean out the blocked main channel culvert so it conveys flow.	Replace the culverts with channel spanning, natural bottom culverts to enhance fish passage and improve conveyance capacity.	Replace the culverts with a bridge. This option would expand the active floodplain downstream of Speckled Avenue to upstream of the road, and enhance fish passage and conveyance capacity.
10	The flood channels in the meadow upstream of Speckled Avenue exhibit evidence of prior channel incision, possibly related to constriction at the road culverts. This incision appears to have been halted by constructed rock grade control. The existing flood channels overbank about every 3 to 4 years. An opportunity exists to increase the frequency of overbanking into the large grassy meadow with high pollutant filtering potential.	Construct in-channel structures (e.g., check dams, rock weirs, large wood) to add channel roughness that would decrease channel capacity and enable more frequent flood channel overbanking onto the grassy meadow.	Obtain a drainage easement to excavate a portion of left and right banks in the private property to create an inset floodplain and increase overbanking onto the meadow.	Purchase the private parcel and excavate a substantial portion to increase overbanking onto the meadow. In conjunction with replacing the Specled Avenue culverts, reconfigure the flood channel connection with the primary channel.
11	Although a flood channel diverts a portion of Griff Creek's high flow at XS 40, overbanking of water into low velocity areas that would enable settling of pollutants occurs rather infrequently in this area. The flood channel may have been the historic primary channel.	Construct in-channel structures (e.g., check dams, rock weirs, large wood) to add channel roughness that would decrease channel capacity and enable more frequent overbanking of the primary and flood channel.	Most of the land in this area is owned by the Sierra Pacific Power Company. The rest is owned by the CTC and a private individual. An opportunity exists to excavate a portion of the land between the primary channel and flood channel to increase the frequency of overbanking.	Make the existing flood channel the primary channel. The new primary channel would potentially have to be enlarged to provide channel stability. This would enable more frequent overbanking since the flood channel has a lower capacity than the primary channel. Maintain the existing primary channel as the new flood channel.
12	A large step in the channel near XS 39 is a potential fish passage barrier.	Reduce the step height by placing rock or large wood in the channel downstream of the step.		
13	A low-water crossing at XS 40 that diverts a portion of the high flow into a flood channel is a barrier to fish passage.	Reconfigure the low-water crossing by elevating the bridge higher over the channel bed to enable fish passage.	Remove the bridge and replace with a natural bottom low-water crossing.	Remove the bridge entirely and restore channel morphology.
14	A culvert is lying longitudinally on the channel bed against the right bank at this location. The purpose of the culvert's placement is not certain. It may have been placed in the channel to provide bank protection, or could be a remnant from the historic road that used to cross Griff Creek here. Fill used to construct the old road east of the channel is a hydrologic barrier to floodplain flow.	Remove the culvert and, if necessary, provide bank stabilization (e.g., rock, large wood, bioengineering).	Remove the culvert and, if necessary, provide bank stabilization (e.g., rock, large wood, bioengineering). In addition, remove the old road fill that is a barrier to floodplain flow.	
15	The channel splits at this location. Most of the flow is diverted into the steeper channel at the base of the east valley wall. An existing grassy meadow located at the channel split is an opportunity to increase pollutant filtering.	Reconfigure the channel split to enable more of the flow to be diverted down the west channel. This would increase overbanking into the grassy meadow.	Excavate a shallow depression near the channel split to allow more overbank water to pond into a wet meadow and settle out pollutants.	
16	The twin circular culverts at Cambridge Drive could be a fish passage barrier.	Reconfigure the channel downstream of the culverts to increase flow depths at the culverts outlets.	Replace the culverts with channel spanning, natural bottom culverts to enhance fish passage and improve conveyance capacity.	Replace the culverts with a bridge. This option would expand the active floodplain downstream of Cambridge Drive to upstream of the road, and enhance fish passage and conveyance capacity.
17	A large step in the channel near XS 56 is a potential fish passage barrier.	Reduce the step height by placing rock or large wood in the channel downstream of the step.		
18	A roadside drainage problem was observed during spring snowmelt flows on the road west of the low-water crossing.	Fill in the road gully and prevent Griff Creek water from flowing down the road.		
19	The NTPUD water tower east of the channel that cuts into the floodplain and constricts flood flow conveyance has resulted in some local channel incision.	Construct in-channel structures (e.g., check dams, rock weirs, large wood) to prevent additional potential incision.		
20	The single circular culvert at Canterbury Drive constricts Griff Creek floodplain and is a potential fish passage barrier at high flows.	Replace the culvert with a channel spanning, natural bottom culvert to enhance fish passage and improve conveyance capacity.	Replace the culvert with a bridge. This option would expand the active floodplain downstream of Canterbury Drive to upstream of the road, and enhance fish passage and conveyance capacity.	


Kings Beach Watershed Improvement Project

Final Hydrologic Conditions Report

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Appendix B-2
Summary of Final Hydrologic Conditions Report

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This report describes the existing hydrologic conditions in the Kings Beach Watershed Improvement Program (WIP) area. The WIP is a component of the Kings Beach Commercial Core Improvement Project (CCIP) which is focused on improving transportation facilities, aesthetics, and storm water quality within the Kings Beach Commercial Core area. Reducing erosion and runoff from the WIP area and providing more opportunities for infiltration and treatment will improve stormwater runoff to Lake Tahoe.

This report describes the estimated annual runoff from the Kings Beach area and also the runoff from specific storm events at various locations in the watersheds. Furthermore, the report summarizes field observations of pollutant sources.

Data sources used in the analysis include the Tahoe Basin soil survey, estimates of impervious surface developed by Desert Research Institute, the Placer County Stormwater Management Manual, field observations of runoff patterns and characteristics, and runoff estimation tools such as HEC-HMS and the SWQIC spreadsheet models.

The WIP area is comprised of two main watersheds: Griff Creek and Kings Beach. The Kings Beach is further subdivided into the Deer, Bear, Coon, Fox, Beaver, and Park subbasins. The annual runoff characteristics were assessed using these subbasins.

ANNUAL RUNOFF

Using the SWQIC runoff spreadsheet (SWQIC 2004), the annual runoff characteristics of the basins were estimated. The model uses historic rainfall and generalized watershed conditions. Data for the model were developed from the GIS database of land use, impervious surfaces, and soils in the area.

The statistical results of the hydrology spreadsheet model are summarized below.

Mean Annual Precipitation	=	26 inches[1]
Average Event Volume	=	0.29 inches
Average Event Duration	=	6.08 hours
Average Inter-Event Duration	=	74.25 hours
Average Number of Events per Year	=	74.2

(1 – Source: Oregon State University, 2002)

	Exceedance Probability		
	5%	**10%**	**50%**
Intensity, in/hr	0.26	0.18	0.09
Volume, in	1.24	0.81	0.18

EVENT-BASED RUNOFF

The response of the WIP area to specific rainfall events was estimated with the model HEC-HMS. Model parameters were estimated from field observations and the Placer County Stormwater Management Manual. The seven subbasins in the Kings Beach watershed were further subdivided to reflect specific hydrologic controls.

Simulations were performed for the following events:

- 2-year, 1-hour storm
- 2-year, 72-hour storm
- 25-year, 1-hour storm
- 25-year, 72-hour storm

Model results indicate that runoff from the Griff Creek watershed had the largest runoff peak and volume for the specific events (Table ES-1 and Table ES-2).

Table ES-1. Total Runoff Volume for Simulated Storms (acre-feet).

Sub-Basin[1]	2-Year / 1-Hour	2-Year / 72-Hour	25-Year / 1-Hour	25 Year / 72-Hour
Griff Creek Outlet	2.0	513.4	4.4	1770.4
Deer Outlet	1.0	13.8	2.4	36.2
Bear Outlet	0.5	26.0	2.1	73.0
Coon Outlet	1.0	62.7	3.6	171.8
Fox Outlet	0.9	13.5	2.6	39.9
Beaver Outlet	0.4	19.2	1.2	54.4
Lakefront Basins				
Secline 1 Outlet	0.1	4.4	0.2	9.5
Brockway 1 Outlet	0.0	2.1	0.1	4.7
Brockway 2 Outlet	0.1	4.4	0.3	9.6
Fox 3b Outlet	0.0	1.7	0.1	3.8
Park 1 Outlet	0.7	48.0	3.0	108.8
Park 2 Outlet	0.2	6.8	0.5	14.5

1 – Outlet refers to the total watershed contributing to Lake Tahoe. For example, Griff Outlet is the contribution of the entire Griff Creek watershed to the lake.

Table ES-2. Peak Discharge for the Simulated Storms.

Sub-Basin[1]	2-Year / 1-Hour Peak Flow (cfs)	2-Year / 1-Hour Time to Peak (min)	2-Year / 72-Hour Peak Flow (cfs)	2-Year / 72-Hour Time to Peak (min)	25-Year / 1-Hour Peak Flow (cfs)	25-Year / 1-Hour Time to Peak (min)	25 Year / 72-Hour Peak Flow (cfs)	25 Year / 72-Hour Time to Peak (min)
Griff Outlet	18.4	68	329.1	810	53.8	50	1199.6	805
Deer Outlet	18.8	48	18.3	720	50.4	44	41.0	720
Bear Outlet	13.2	78	30.0	720	48.0	54	76.8	720
Coon Outlet	27.4	92	69.5	750	125.4	68	169.5	745
Fox Outlet	21.2	54	22.1	725	62.2	44	50.4	720
Beaver Outlet	10.8	64	22.9	720	28.7	44	60.1	720
Lakefront Basins								
Secline 1 Outlet	1.0	60	4.4	720	5.2	34	9.1	720
Brockway 1 Outlet	0.4	60	2.2	720	2.1	36	4.5	720
Brockway 2 Outlet	1.4	32	4.4	720	5.7	36	9.1	720
Fox 3b Outlet	0.4	30	1.8	720	2.2	32	3.6	720
Park 1	13.5	60	46.2	720	74.7	32	96.9	720
Park 2	3.2	32	6.7	720	10.5	34	13.7	720

1 – Outlet refers to the total watershed contributing to Lake Tahoe. For example, Griff Outlet is the contribution of the entire Griff Creek watershed to the lake.

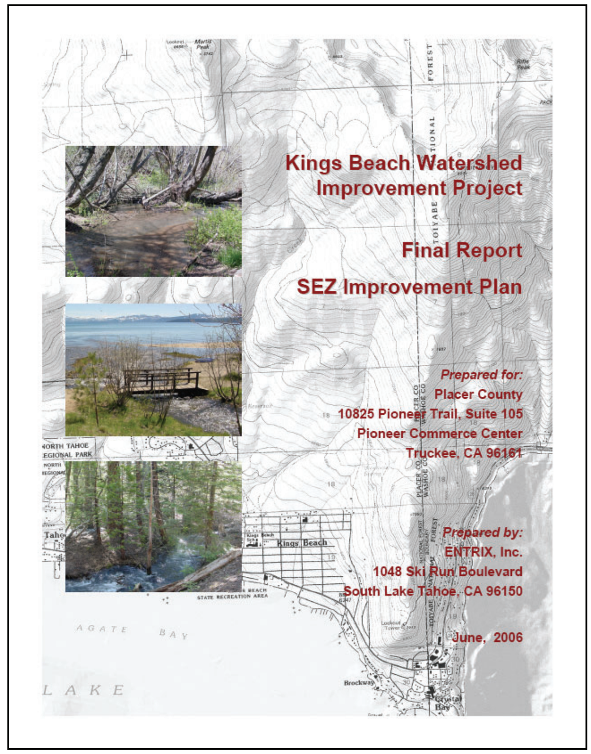
Land use conditions for the WIP area data were estimated from the GIS database and field observations. The land use conditions and the results of the annual hydrograph spreadsheet model were utilized in the SWQIC water quality spreadsheet. The spreadsheet model estimated pollutant loading based on land use, runoff conditions, and the connection between land areas and discharge points (Table ES-3). The results indicate that while the Griff Creek watershed produces the largest volume of sediment and other pollutants, the pollutant loading as a function of contributing area is the smallest. The Coon subbasin produces the highest suspended sediment load per acre. The Bear and Park subbasins also produce significant sediment loads relative to contributing area.

Potential sources of sediment and other pollutants were identified through extensive field analysis of the WIP area.

Table ES-3. Results of the Water Quality Loading Analysis.

Water Quality Parameter	Pollutant Load (tons/year)						
	Griff	**Deer**	**Bear**	**Coon**	**Fox**	**Beaver**	**Park**
NO3	0.006	0.002	0.002	0.006	0.003	0.002	0.003
TKN	0.155	0.017	0.018	0.051	0.022	0.016	0.021
SRP	0.020	0.002	0.002	0.007	0.002	0.002	0.003
TP	0.052	0.011	0.009	0.027	0.014	0.010	0.010
TSS	6.889	3.804	2.733	7.666	4.670	3.006	3.136
Watershed Area (acres)	2815.29	61.09	133.15	355.79	82.61	94.10	125.29
TSS Loading (lbs/acre)	4.9	124.5	41.1	43.1	113.1	63.9	50.1

Source: SWQIC 2004.



Appendix B-3
Summary of Final SEZ Improvement Plan Report

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The purpose of this report is to evaluate and identify a recommended restoration alternative for the Griff Creek SEZ within the Kings Beach WIP.

The SEZ Existing Conditions and Alternatives Report (Placer County, 2006) identified opportunities and constraints for enhancing the Griff Creek SEZ. Twenty priority areas were identified in which water quality, geomorphic channel stability, floodplain connectivity, riparian habitats, and fish passage could be improved. These priority areas are referred to as enhancement sites. Each enhancement site has up to three alternatives that could be implemented (at some locations where fewer enhancement options are available, only one or two alternatives were developed).

This report includes a series of planview figures depicting each alternative in groups of 3 to 4 enhancement sites. The figures show general parcel ownership, existing and proposed stream channels, proposed road crossing modifications, constructed habitat, bank stabilization, grade control features, and proposed floodplain excavation. A series of cross-section drawings are also presented to illustrate the concepts of the alternatives at representative enhancement sites. The drawings are intended to show the major topographic changes that would occur between existing and proposed ground surfaces, and how these changes alter the relationship of typical annual snowmelt runoff with potential overbank areas.

Each alternative was evaluated as Good, Better, or Best based on five criteria (Water Quality, Fish Passage and Habitat, Cost, Operation and Maintenance, and Feasibility). From the evaluation, a recommended alternative for each enhancement site was chosen. Table ES-1 presents the recommended alternative for each enhancement site in the Griff Creek SEZ.

EXCAVATION AND EASEMENTS FOR THE RECOMMENDED ALTERNATIVE

A concept-level hydraulic analysis was conducted to assess the viability of the recommended alternative, the size of needed channel and floodplain modifications, and the extent of easements needed to move the project forward. Easements will be needed whenever modifications are proposed for a parcel or access is required. It is assumed that easements for public land will be addressed through license agreements. Easements on private land will have to be negotiated with the property owner(s) and purchased at fair market value. 33 private parcels have been identified that will require easements.

FUNDING AND PERMITTING

Funding for design and construction will come from several sources. Potential funding sources are identified in Section 6.0. Permits necessary for this project are also listed in Section 6.0.

Table ES-1. Recommended Alternatives for Griff Creek Enhancement Sites

Enhancement Site Number	Enhancement Site Opportunity	Recommended Alternative	Recommended Alternative Description
1	Griff Creek downstream of Highway 28 is a trapezoidal, rip-rapped channel constructed in 1984 as part of Placer County's Phase I Erosion Control Project. Because of the channel's high conveyance capacity, a 50 to 100 year flow event is needed for overbanking to occur, limiting any SEZ connection. The high terrace east of the channel has little ecological value and no Griff Creek pollutant filtering potential. Furthermore the uniform channel bed has little hydraulic diversity to support aquatic habitat and offers little fish refuge from high velocity streamflows.	2	Excavate a portion of the left bank fill on the Placer County owned parcel east of the channel to create a new floodplain surface. Remove the left bank rip-rap to enhance fish habitat and enable lateral channel movement. Leave a buffer of existing high ground at the boundary with CTC land to provide flood protection for adjacent properties and infrastructure. While Alternative 3 would create a larger floodplain area, the added cost would not provide equally added water quality benefits. The CTC parcel is located relatively far from the primary channel and is located in the hydraulic shadow downstream of the gas station at the corner of Highway 28 and Secline Street. In addition, Alternative 2 would maintain the existing ground surface of the CTC parcel for potential future application in treating Secline Street runoff (e.g., sediment basin), which will be determined in the water quality alternatives component. Total estimated cost $63,750.
2	Highway 28 culverts do not meet conveyance requirements of CALTRANS and the Placer County SWMM (MACTEC, 2003). Furthermore, they are a temporal barrier to fish passage and prevent any potential floodplain connectivity up and downstream of Highway 28.	2	Replace the triple arch CMP culverts and twin circular CMP culverts with channel spanning, natural bottom culverts, such as a triple barrel concrete arch structure, to enhance fish passage and improve channel and floodplain conveyance capacity. The added cost of constructing a bridge (Alternative 3) would not provide equally added water quality benefits. Hydraulic connectivity between the proposed new floodplain excavations up and downstream of Highway 28 could be achieved by constructing multi-barrel natural bottom culverts. A bridge may be warranted if the gas station at the corner of Highway 28 and Secline Street were removed and a wider floodplain could be created Total estimated cost $746,250.
3	The function of the in-channel sediment basin upstream of Highway 28 has the potential to be enhanced. The trapezoidal, rip-rapped channel constructed in 1984 as part of Placer County's Phase I Erosion Control Project upstream of Highway 28 has high flow conveyance capacity and only overbanks approximately every 9 to 10 years.	2	Excavate a substantial portion of the large Placer County parcel east of the channel to create a new floodplain surface. Remove the left bank rip-rap to enhance fish habitat and enable lateral channel movement. Construct a floodplain swale that would divert some of the high flow into the new floodplain where sediment and nutrients could be deposited and stored. Maintain and periodically dredge the in-channel sediment basin. Since Placer County owns this land, it is a great opportunity to create new floodplain. The option to maintain the existing in-channel sediment basin was chosen (as opposed to Alternative 3) because it has the potential to trap pollutants at low and high flows. Development of a management plan to periodically dredge the basin could enhance its effectiveness. The existing primary channel would be retained to make this alternative compatible with the recommended alternative upstream at enhancement site 4. Total estimated cost $52,500.

Table ES-1. Recommended Alternatives for Griff Creek Enhancement Sites (continued)

Enhancement Site Number	Enhancement Site Opportunity	Recommended Alternative	Recommended Alternative Description
4	This is the most incised Griff Creek reach and the largest channel source of fine-grained sediment from bank failure. Parcels on both sides of the channel are privately owned. The land east of the channel is largely an undeveloped, abandoned floodplain with remnant channels. The primary channel overbanks into the abandoned floodplain about once every 4 to 8 years.	2	Obtain a drainage easement along the left bank and excavate a portion of the left bank to create a new inset floodplain re-connected to the existing primary channel. Possibly divert some of the high flow in the primary channel upstream into the remnant channels located in the northern half of the site. Construct bank stabilization along sections of the eroding banks (e.g., rock wall, large wood, and bio-engineering). While Alternative 3 would create a larger floodplain area, the added cost and lower feasibility would not provide equally added water quality benefits. The two downstream-most parcels in this enhancement site have existing homes. This property would likely have to be purchased if Alternative 3 were implemented. By maintaining the primary channel in its current location and excavating a floodplain strip, this alternative has a greater feasibility of being accomplished through a drainage easement than Alternative 3. Much of the land in the enhancement site has healthy riparian vegetation, and excavating an extensive floodplain would remove this vegetation Total estimated cost $168,750.
5	The two parcels in this area disrupt the longitudinal connectivity of the left floodplain. Upstream of these parcels, the floodplain is active, with fairly regular overbanking events. The abandoned floodplain downstream of these parcels is not inundated as frequently. Griff Creek is also incised in this reach and has sections of unstable banks.	2	Excavate a portion of the left bank to create a new inset floodplain re-connected to the existing primary channel. The new floodplain would provide a link with the active floodplain upstream and the abandoned floodplain downstream. Construct bank stabilization along sections of the eroding banks (e.g., rock wall, large wood, and bio-engineering). This recommended alternative is compatible with the recommended alternatives up and downstream at enhancement sites 4 and 6. This alternative could be accomplished through a drainage easement, while Alternative 3 would likely require an entire private property purchase since there is a home on the downstream-most parcel. Total estimated cost $168.750.
6	The land east of the channel is active floodplain. Griff Creek is less incised in this reach than downstream. The channel overbanks into the floodplain about once every 4 to 5 years. The floodplain is actively supported by diversion of some of the high flow at Dolly Varden Avenue into a flood channel that traverses through the floodplain. Overbanking of the flood channel(s) currently provides the best pollutant filtering opportunity on lower Griff Creek.	2	In a slight modification of Alternative 2, construct a new floodplain swale just downstream of the Dolly Varden Avenue road crossing that would connect with the new floodplain swale proposed upstream at enhancement sites 7 and 8 (as originally proposed in Alternative 3). The new swale would divert a higher percentage of Griff Creek's flow into the existing active floodplain. Also, construct in-channel grade control features (e.g., check dams, rock weirs, large wood) to prevent additional potential incision of the primary channel and downstream end of the floodplain swale. Structures would also add channel roughness that would decrease channel capacity and enable overbanking to occur at a somewhat lower discharge. This alternative is recommended because it would not only add bank stabilization and grade control features to arrest future primary channel incision, but it would also enhance flooding of the active floodplain without disturbing the existing healthy riparian vegetation community. Total estimated cost $112,500.

Table ES-1. Recommended Alternatives for Griff Creek Enhancement Sites (continued)

Enhancement Site Number	Enhancement Site Opportunity	Recommended Alternative	Recommended Alternative Description
7	The culverts at Dolly Varden Avenue are a barrier to floodplain flow and provide poor fish passage and high flow conveyance. The right circular CMP culvert outlet at Dolly Varden Avenue is suspended about 1 foot above the low-flow water surface and is a barrier to fish passage.	2	Make no modifications to the west secondary channel (enhancement site 8) and the right circular CMP culvert. Replace the left arch CMP culvert on the primary channel with a channel spanning, natural bottom culvert, such as a single or double barrel concrete arch structure, to enhance fish passage and improve channel and floodplain conveyance capacity. Install a separate box culvert for the new proposed floodplain swale upstream of Dolly Varden Avenue (enhancement site 8) to connect with the existing floodplain downstream. Total estimated cost $227,500.
8	Urban encroachment along Griff Creek's right bank and modification of the channel is extensive in this reach. Although Griff Creek is less incised upstream of Dolly Varden Avenue compared to reaches downstream, existing overbank opportunities are still limited, and only occur about once every 4 to 5 years. A great opportunity is available to enhance the hydrologic connectivity between the channel and the undeveloped CTC land east of the channel.	3	Excavate a floodplain and new floodplain swale through the CTC's property east of the main channel, including removal of a portion of the berm paralleling the upstream side of Dolly Varden Avenue. The existing ground on private property would remain as a vegetated island between the new floodplain and existing primary channel. The CTC-owned parcels east of Griff Creek at this site are a great opportunity for enhanced water quality. This alternative is recommended over Alternative 2 because it would not require purchasing easements of private property, and would cause minimal disturbance of the existing riparian vegetation. Total estimated cost $176,250.
9	The culverts at Speckled Avenue are in poor condition. The small circular CMP culvert right of the main channel that conveys water from the meadow flood channels is undersized, its outlet is submerged, and provides poor fish passage. Incision of the meadow flood channels upstream of the culvert may be related to the configuration of this culvert. The right culvert of the two twin arch CMP main channel culverts is blocked and does not convey any flow.	2	Replace the left twin arch CMP culverts with a channel spanning, natural bottom culvert, such as a concrete arch structure, to enhance fish passage and improve channel and floodplain conveyance capacity. Replace the right meadow circular culvert with a new box culvert. Total estimated cost $227,500.
10	The flood channels in the meadow upstream of Speckled Avenue exhibit evidence of prior channel incision, possibly related to poor alignment with the road culverts. This incision appears to have been arrested by constructed rock grade control. The existing flood channels overbank about every 3 to 4 years. An opportunity exists to increase the frequency of overbanking into the large grassy meadow with high pollutant filtering potential.	3	Construct an in-channel structure (e.g., check dams, rock weirs, large wood) to prevent additional future incision of the meadow channels. Also, excavate a relatively large floodplain in the area of meadow channels to increase overbanking onto the meadow. This alternative is recommended over Alternative 1 because excavating floodplain would be more effective at increasing overbanking frequency than construction of in-channel structures. The larger excavation area is recommended over the smaller area of Alternative 2 since it would create a continuous floodplain surface by connecting with the existing active floodplain upstream of the site. Total estimated cost $178,750.

Table ES-1. Recommended Alternatives for Griff Creek Enhancement Sites (continued)

Enhancement Site Number	Enhancement Site Opportunity	Recommended Alternative	Recommended Alternative Description
11	Although a flood channel diverts a portion of Griff Creek's high flow at upstream at enhancement site 14, overbanking of water into low velocity areas that would enable settling of pollutants occurs somewhat infrequently in this area. The existing flood channel may have been the historic primary channel.	1	Construct in-channel structures (e.g., check dams, rock weirs, large wood) to add channel roughness that would decrease channel capacity and enable more frequent overbanking of the primary channel. The area between the existing primary and flood channels is healthy riparian vegetation. This alternative is recommended over Alternative 2 because it would not excavate floodplain and disturb the existing riparian vegetation for relatively small water quality gain. Total estimated cost $50,000.
12	A large step in the channel is a potential fish passage barrier.	1	Reduce the step height by placing rock or large wood in the channel downstream of the step. Total estimated cost $18,750.
13	A low-water bridge that diverts a portion of the high flow into a flood channel is a barrier to fish passage.	3	Remove the bridge entirely and restore channel morphology. Unless this bridge is legal and access across it is required, it should be removed and not replaced. Total estimated cost $10,000.
14	An old culvert is lying longitudinally on the channel bed against the right bank at this location. The purpose of the culvert's placement is not certain. It may have been placed in the channel to provide bank protection, or could be a remnant from the historic road that used to cross Griff Creek. Fill used to construct the old road east of the channel is a hydrologic barrier to floodplain flow.	2	Remove the culvert and, if necessary, provide bank stabilization (e.g., rock, large wood, bio-engineering). In addition, remove the old road fill east of the channel that is a barrier to floodplain flow. The historic road crossing of Griff Creek at this location no longer exists. It appears that the original function of this fill as an approach to the crossing is no longer necessary, and should be removed. Total estimated cost $12,500.
15	The channel splits at this location. Most of the flow is diverted into the steeper channel at the base of the east valley wall. An existing grassy meadow located at the channel split is an opportunity to increase pollutant filtering.	1	Reconfigure the channel split to enable more of the flow to be diverted down the west channel. This would increase overbanking into the grassy meadow. This alternative is the least costly, requires minimal engineering, and provides water quality benefit. Total estimated cost $5,000.
16	The twin circular CMP culverts at Cambridge Drive are a fish passage barrier during high and low flows since the outlets are not at grade with the channel bed, and are a hydrologic barrier to floodplain connectivity.	2	Replace the twin circular CMP culverts with a channel spanning, natural bottom culvert, such as a single or double barrel concrete arch structure, to enhance fish passage and improve channel and floodplain conveyance capacity. Total estimated cost $227,500.
17	A large step in the channel is a potential fish passage barrier.	1	Reduce the step height by placing rock or large wood in the channel downstream of the step. Total estimated cost $10,000.

Table ES-1. Recommended Alternatives for Griff Creek Enhancement Sites (continued)

Enhancement Site Number	Enhancement Site Opportunity	Recommended Alternative	Recommended Alternative Description
18	A roadside drainage problem was observed during spring snowmelt flows on the road west of the low-water crossing.	1	Fill in the road gully and prevent Griff Creek water from flowing down the road and re-forming a gully. Total estimated cost $5,000.
19	The North Tahoe Public Utility District (NTPUD) water tower east of the channel that cuts into the floodplain and constricts flood flow conveyance has resulted in some local channel incision.	1	Construct in-channel structures (e.g., check dams, rock weirs, large wood) to prevent additional potential incision. Total estimated cost $15,000.
20	The single circular CMP culvert at Canterbury Drive constricts Griff Creek floodplain and is a potential fish passage barrier at high flows.	None	Maintain existing culvert. The valley floor up and downstream of Canterbury Drive is steep and confined with little opportunity for flooding. Furthermore, Canterbury Drive is elevated on approximately 30 feet of road fill over Griff Creek. The cost of replacing the existing culvert would not provide equally added water quality benefits. Total estimated cost $0.
	Total estimated cost for recommended enhancement opportunities:		$1,476,250

Appendix B-4
Summary of Final Review Alternatives Memorandum

This Review Alternatives Memorandum evaluates the alternatives previously developed by Placer County for the Kings Beach Watershed Improvement Project (WIP). These alternatives represent approaches to reducing the loading of sediment and nutrients originating in the WIP area that flow to Lake Tahoe.

Additional data were collected that identified the sources of pollutants and the transport mechanisms in the WIP area. As part of this Project, the initial alternatives were enhanced with the new data collected in 2005. From this effort, three enhanced alternatives emerged for the WIP. This report presents the enhanced alternatives.

The WIP area contains extensive undeveloped forestland to the north and east of the developed urban core. The urban core included homes, offices, stores, parks, and a major highway. There is also undeveloped land in the urban core. Pollutants are generated in the urban core through soil erosion, road-sanding operations, application of fertilizer, and other urban uses (vehicle travel, pets, litter, garbage). There are two approaches proposed in this report for controlling the pollutant loading: source control and treatment.

This report lists the top 75 water quality problems in the WIP area that were identified in summer 2005, and proposes four methods of controlling the pollutants at the source. These methods are:

- Revegetate eroding areas in the right-of-way;
- Prevent parking or vehicular travel off of paved surfaces;
- Pave areas that are used for vehicular travel; and
- Work with landowners to implement backyard Best Management Practices to control pollutants that originate from private parcels.

Controlling pollutants at the source does not completely eliminate pollutant loading to the lake. Additional measures are proposed to convey, collect, and treat runoff. Three alternatives are presented to collect and treat runoff. They include:

- Collect and treat runoff within small areas of each hydrologic sub-basin (localized approach);
- Collect and treat runoff at the subbasin level (basin-wide approach); and
- Use curb and gutter to direct runoff to several sand filters and settling basins to treat runoff from the WIP area (regional approach).

Each of the three alternatives is combined with the source control solution to address the water quality issues in the WIP area.

The next step is to develop and evaluate a final set of alternatives and select a preferred alternative.

Appendix B-5
Summary of Final Evaluating Alternatives Technical Memorandum

The Kings Beach Watershed Improvement Project (WIP) seeks to improve the quality of runoff that is generated in the Kings Beach watershed and flows to Lake Tahoe. Three alternatives to improve water quality in the Project area were developed and described in the Final Review Alternatives Memorandum (ENTRIX 2006a). The next step in development of the WIP is to select a Preferred Alternative by evaluating each alternative using a common set of criteria based on the goals of the WIP to determine which alternative best meets these goals. This document is a report on the results of the evaluation process.

NOTE: Griff Creek and the Griff Creek sub-basin are located within the Kings Beach WIP; however, any proposed improvements to Griff Creek are described in the Final SEZ Improvement Plan, June 2006 (ENTRIX 2006b).

The water quality alternatives consist of three urban approaches to address urban runoff volume and improve water quality based on land area. They are scaled from the smallest to the largest as follows:

Alternative A: Localized approach;

Alternative B: Basin-wide approach; and

Alternative C: Regional approach.

Briefly, the localized approach collects and treats urban runoff for areas smaller than the delineated sub-basins by promoting localized infiltration and treatment. These areas are approximately the size of a street block. The basin-wide approach collects and treats urban runoff at the sub-basin scale. The regional approach collects and treats urban runoff from the entire Project area and is treated by several sand filters, media filters, and holding tanks before discharging to the lake.

SUMMARY OF EXISTING CONDITIONS

The existing conditions in the Project area have been described in previous documents prepared for this Project. The data presented in the documents were used to initially develop the three Project alternatives and were additionally used in the evaluation of the alternatives. The primary data used in the evaluation are summarized below.

- Surface Hydrology
- Water Quality Pollutants
- Land Use

EVALUATION METHOD AND RANKING CRITERION

The three alternatives were evaluated based on five ranking criteria that include water quality, capital cost, feasibility, operations and maintenance cost, and land acquisition. The criteria were then ranked using a one to five scale, with a five as the optimum rank and 1 as the least favorable. The evaluation methodology was described in a memorandum prepared by ENTRIX and reviewed by the Kings Beach TAC (ENTRIX 2006d). This methodology was used to evaluate and rank the three alternatives using existing conditions within the Project area as a basis for the qualitative and quantitative assessments relating to each alternative.

A matrix approach was used to determine a numerical ranking for each of the five criteria. Quantitative measures used in the analysis include estimations of the percent reduction in pollutant loading, the total cost of construction, equipment, operation and maintenance, and the cost of land acquisition. Qualitative measures involving knowledge about the Project area, professional judgment as to the feasibility of BMPs, and applying agency and public comments received during Project coordination meetings were used in the evaluation.

Additionally, a weighting factor based on TAC discussion and agreement, was integrated into the evaluation score.

EVALUATION RESULTS AND THE PREFERRED ALTERNATIVE

The information, assumptions, and professional judgment included in this report were used to rank the three alternatives based on the five ranking criteria. A summary of the results is shown in Table ES-1. The rankings for each criterion were multiplied by the corresponding weighting value, then summed for an overall ranking.

Table ES-1. Summary of Alternative Rankings.

Evaluation Criteria	Weighting Value	Alternative A	Alternative B	Alternative C
Water Quality	40%	1	3	2
Capital Cost	20%	3	2	1
Feasibility	10%	3.5	3.0	2.7
Operations and Maintenance	20%	4	4	3
Land Acquisition	10%	3	3	5
Final Rank		**2.45**	**3.0**	**2.37**

The final rankings indicate that Alternative B has the highest ranking, although all three alternatives rank similar in several criteria. Due to the similar rankings of all three alternatives, individual criteria such as water quality, cost, and cost benefit ratios are compared against the alternatives to develop the best alternative that represents the goals of Placer County and the TAC. The water quality simulations discussed in this report indicate that Alternatives A and B provide a means of reducing and treating the flow to the commercial core and Alternative C provides the best treatment opportunity within the commercial core. The water quality assessment also suggests that Alternative B provides the greatest reduction in fine sediment of the three alternatives, overall, and in the individual sub-basins. Alternative A and B are similar under several of the evaluation criteria such as O&M and Land Acquisition, but differ the most with the percent reduction in sediment loading. The unit cost per water quality benefit also shows that while Alternative B is more expensive than Alternative A, the benefits for improvement in water quality are greater. The largest limitation to water quality improvement with Alternative C is that the localized water treatment facilities are limited by a 1 cfs capacity.

The best approach to achieve water quality benefits may be separation and treatment of runoff within the primary land use categories (forest, residential, and commercial core). The reason is, even though treatment in the commercial core provides the best opportunity for water quality improvement, the commercial core system can be overwhelmed with the volume of runoff from the forest and the residential areas under Alternatives A and B. This suggests that a preferred strategy should be to remove the forest runoff from the residential and commercial treatment train, treat the residential area with Alternative B, and treat the commercial core with a combination of sand filters and media filters. The separation of runoff between the residential area and the commercial core reduces the volume of runoff treated by the sand and media filters, thereby reducing the volume of runoff that has to be bypassed due to the limited capacity of the sand and media filters.

Therefore, the Preferred Project Alternative is Alternative B, the basin wide approach, with some additional media filters which are proposed in Alternative C. Alternative B would reduce fine sediment loads by 51 percent, and the addition of media filters at the bottom of the watershed would further reduce fine sediment loads to the lake.

Elements of the Preferred Alternative would include:

- Encouraging homeowner’s to install BMPs (source control);
- Collecting forest runoff and conveyance to Griff Creek or Lake Tahoe;
- Constructing grass-lined swales where they can be supported to convey runoff along the right-of-way and promote infiltration;
- Constructing rock-lined channels to convey water along the right-of-way and promote infiltration;
- Installing basins to collect and retain runoff;
- Constructing infiltration galleries to retain runoff; and
- Installing media filters to treat runoff from the commercial core and Brockway Vista Avenue.